USE OF PICLORAM TO OBTAIN ROOTKILL OF WOODY PLANTS, IN PRACTICABLE RIGHTOFWAY VEGETATION MANAGEMENT, 1984*

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This is the third Annual Progress Report on the use of picloram (Phytologia 55(6):361-364, VI '84 and 56(5):365-367, XII '84 --q.v. for detailed methods et al.) for effecting ROOTkill of woody plants considered desirable and undesirable in practicable R/W Vegetation Management in the northeastern United States.

HISTORY, PROCEDURE AND RESULTS. The work is done on 25 acres of herbicide-induced essentially stable Herblands and Shrublands (managed since 1926, with herbicides since 1946, with picloram pellets since 1978, with liquid picloram since 1980) of 1100-acre Aton Forest in the Beech-Birch-Maple-Hemlock Zone of New England, plus 1.5 miles of utility-line-covered roadside (Phytologia 55(6):345-360), 2 miles of forest trails, some forest understories, and several other small areas. Picloram is the triisopropanolamine salt of 4-amino-3,5,6-trichloropicolinic acid. It was used as Dow's "Tordon RTU" (meaning Ready To Use, tho we used it half-strength with water), containing 5.4% picloram and 20.9 % of a comparable 2,4-D (the latter added in part for marketing enhancement). Egler abandoned 2,4-D in 1949 as being ineffective in ROOTkilling, in comparison to 2,4,5-%, itself not too effective on many species and abandoned in 1965).

To test for different seasonal effects, different tracts of land were assigned for the eight months from April thru November (with some spraying elsewhere when possible in the winter months). After three years, no striking monthly differences have yet appeared.

In 1982, 45,570 stubs of 97 species were treated. In 1983, 55,667 stubs were treated. Now, in 1984, 39,253 stubs were treated. Numbers alone are misleading. Some of the plants are clonal, and 50-100% of the ramets are treated. For non-clonal trees and shrubs, 1-100% of the branches (at varying heights) are treated. Many have variably resprouted, and these are treated 1-3 years later, sometimes with 8-12 resprouts where there had been one stem originally. Treatment was with a 1½ qt. plastic sprayer and pruning shears, by downward bark-scraping for 6-10 inches with a

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small folding saw, with discontinuous hatchet-made "cups", or by continuous ringing. The 39,253 stubs took 202 on-the-job hours, thus averaging 194 stubs per hour (an average of little meaning). There was a variation from 50 to 500 stubs per hour, depending largely on the number of trees involved (to 3 in. in dm. and 25 ft. in height), on the concentration and density of stubs per unit area, and on the alacrity and alertness of the operator. Of the 97 woody species (plus a few undesirable herbs) in this study, the following 12 are most abundant in 1984, listed in order of abundance: Red Maple (Acer rubrum),Meadowsweet (Spiraea latifolia), Arrowwood (Viburnum recognitum), Maleberry (Lyonia ligustrina), Choke Cherry (Prunus virginiana), Sugar Maple (Acer saccharum), Winter Holly (Ilex verticilla), White Ash (Fraxinus americana), Highbush Blueberry (Vaccinium corybosum). Beech (Fagus grandifolia), (in forest trails),and Striped Maple (Acer pensylvanicum) (in forest trails).

Tordon pellets were used at about 100 spots, mainly for isolated Meadowsweet, Common Juniper (Juniferus communis), and Low Blueberry (Vaccinium pensylvanicum) plants which are otherwise time-consuming to treat. Quantity of picloram varied, depending on size and areal extent of the plant --from a tablespoon to 4 tablespoons, applied on the uphill side (assuming it would move downhill with the soil solution). To date, the technique seems desirable (when some off-target kill can be tolerated), with root absorption beginning after several weeks, and with persisting grasses and mosses preventing soil erosion. Further tests are essential.

This ROOTkilling study is directed, A, towards knowing what desirable shrubs are ROOTkilled in indiscriminate aerial and blanket commercial spraying on R/Ws, and what undesirable trees are not ROOTkilled (leading to additional iatrogenic spraying in the future); and B, towards the creation of a variety of herbaceous and shrubby Cover Types (plant communities), which are essentially stable (contrary to much ecology textbook dogma), and which Cover Types can be the objective in R/W construction and management for a life-of-line 50-year program, as first proposed to the utility industry by Egler in 1949, and in many subsequent publications directed also to such fields as academic ecology, highwayside Vegetation, pipelines, railroad sides, esthetic landscapes, and wildlife habitat.

DISCUSSION. The data for 1984 extend and substantiate the findings of recent years with respect to picloram control. Picloram properly applied is a more effective ROOTkiller than either 2,4-D or 2,4,5-T (the use of which, 1946-1965, resulted in heavy take-over by old and new Red Maple, Sugar Maple, Ash and Oak, as well as Meadowsweet, Maleberry and Arrowwood.

All experiments on time-saving high stubbing (waist high) treatments are highly variable in results, and cannot be recommended for commercial practice. At times, complete ROOTkill is attained, even from treating 50% of the shoots of Red Maple. But in other cases, there is kill-down for only 10 inches, with prolific resprouting on the main stem and from the ground.

Ash is by far the most resistant species, vigorously resprouting a few inches below the treated stub. Effective application is complicated by the fact that many seedlings flatten under the grass mulch and grow erect 6-12 in. from the actual rootcollar.

Beech rootsuckers -- on the basis of the stub-spraying on the forest trails -- when treated low, do not resprout and the effect does not flash-over to nearby off-the-trail rootsuckers.

One 25-ft. Striped Maple was treated with but one breast-high 2 x 4 in. bark-removed spot. Two years later, the tree was dead.

Conifers (resistant to herbicides) were cut only, with an axe or saw, even Common Juniper.

Low-stubbing, defined as 12 in. or less from the ground, involving at least 75% of the stems of shrubs, is recommended even tho the procedure is more time-consuming. In this procedure, there is an advantage in bending over and stepping on one or more stems with the left foot, then cutting with the pruning shears, whence the cut stem springs up above the herbage, conspicuous for spraying with the left hand (if you are right-handed).

Concomitant uncontrollable and unpredictable factors in these treatments include: variable quantities of spray applied per stub by the operator; unavoidable splash onto surrounding soil from the plastic sprayer (especially obvious with snow on the ground); wash-off by rain 12-24 hours after spraying (especially that running down the impermeable bark); herbivorous effects by deer, hare, rabbits, mice, especially in winter, that can have the effect of "over-grazing" (tho animal populations vary enormously within a 5-30 year period) -- all make some 2-year quickie-research projects scientifically unreliable. Browsing of such post-spraying resprouting appears in some cases to result in the final ROOTkilling.

Competition and/or allelopathy by such densely growing plants as Spiraea, Rough-stemmed Goldenrod (Solidago rugosa) and ferns seems also to result in the final ROOTkilling. "The cheapest herbicide is often other plants" as much of the literature indicates.

PLANT PHYSIOLOGY. Movement thru the plant of the herbicide becomes apparent to the observant field investigator. Downward movement in the stem phloem so as to kill the roots of stump-sprouting trees--tho of greatest importance to the person who has brush to kill, and often stressed in sales literature of the chemical manufacturers --is something that does not happen with most herbicides, thus leading to costly re-treatments, often credited to new "seedlings". Some downward movement in the phloem may take place if the herbicide is linked to the downward-moving photosynthates in autumn (unpublished research on Staghorn Sumach, (Rhus typhina,1948) but field evidence is still inconclusive. And movement of the herbicide applied to low stubs of Bristly Locust (Robinia hispida) and Trembling Aspen (Populus tremuloides) does quickly affect ramets of the clone 10-20 feet away. But this movement is "upward" in the sense that it occurs in the direction of water-and-nutrient flow to the transpiring leaf surfaces.

Upward movement of picloram is amazingly rapid (an item of high market value, as supported by color photography). A summer-bark-scraped 12-ft. high Black Cherry showed foliage discoloration 24 hrs. later. The foliage was completely brown and dry in two weeks. Such quick photogenic top-kill of an undesirable species (only a chemical mowing, analogous to the physical mowing of a morning shave) may or may not result in prolific stump-sprouting, or root-suckering at a distance. From another viewpoint, ROOTkill may be dependent not on herbicide-killing, but on root-starvation by complete phloem-kill, preventing the downward movement of photosynthates, and depleting the food already in the roots, necessary to the life of the roots.

It is obvious that even tho a single shoot of tree or shrub may be entirely killed, the chemical usually does not move "across" to other shoots within the root-crown, for those other shoots may remain unaffected. Thus the field applicator judges which shoots to treat by their apparent separateness at the soil surface.

In the second and often third year after a treatment, terminal branches on such as Highbush Blueberry may be heavily killed back. Then new sprouts will adventitiously arise back 12-24 in. from the tips, growing erect and vigorously, or others will arise from the ground. The implication is that the upwardly moving herbicide accumulated in the terminal twigs, and killed them; the remaining chemical in the plant eventually disappeared; and new growth is now dominating.

IN-SOIL MOVEMENT. Movement thru the soil of the herbicide becomes one of the chief problems with picloram. The chemical is highly water-soluble, relatively persistent, and can thus travel thru the soil solution either by diffusion beyond the area of the roots of the treated plant, or en masse with the soil water itself, as in spring thaws. Desirable plants have been ROOTkilled 30 ft.

from a spot application.

One hears the statement that picloram is released from killed and decaying roots, to be picked up by the roots of other woody plants, to kill again in the name of "brush control" - unless(as the real argument goes) it hits off-target species. The senior author has no field observations yet to support this argument.

A case with Forsythia is significant. The plastic applicator with pressure unreleased was by custom left on a granite doorstep. A few drops would drip from the nozzle. Rains apparently washed the picloram to the adjacent soil. A 6-ft. espaliered Forsythia, 6 ft. away, picked up the chemical. But only that half of the plant on the step-side was affected, with foliage curled and distorted. The distant side was entirely unaffected. It would appear therefor, that roots, and the branches directly above them, are connected, but that there is no effective movement within the plant "across" to other parts of the plant.

FURTHER STUDIES. This is the third and last year of extensive liquid picloram applications. After two years of preliminary trials, and after three years of treating 140,490 stubs of 97 species, of various shapes and sizes, at various seasons, the 25-plus acres will be watched for resurgence and for ROOTkill. Other herbicides will be tested in the future on other areas.

It should be remembered that all such ROOTkill research serves only as the first step in plant-community research that has been ongoing since 1931 at Aton Forest. That research is concerned with the relative stabilities of the resulting Herblands and Shrublands, with the Shrublands long proving far more stable than the Herblands. (Mss. now in preparation.) Indeed, no shrub at AF has yet been found which autogenically changes the site so as to destroy itself, and to facilitate the invasion of trees, in the manner of the still-alive undocumented dogma of Clementsian plant-succession-to-climax, as opposed to the relative importance of Initial Floristic Composition (Egler, 1954. Vegetatio 4(6):412-417). Physiognomic "succession" from shrubland to forestland has been primarily due to trees that started antecedent to or concomitant with shrubs -- a fact of immense academic and practical importance to Vegetation Science and Vegetation Management. These continuing long-term studies on ROOTkill are aimed at further experimenting upon only one aspect of Vegetation Change: ROOTkilling the presumed-by-others later shrub and tree invaders--so as to test for the relative stability of the remaining plant-communities, not for the duration of an NSF grant, but for an entire century or more.

End.